Extraction of organosolv pulp and nanocellulose from post-harvest residues of corn

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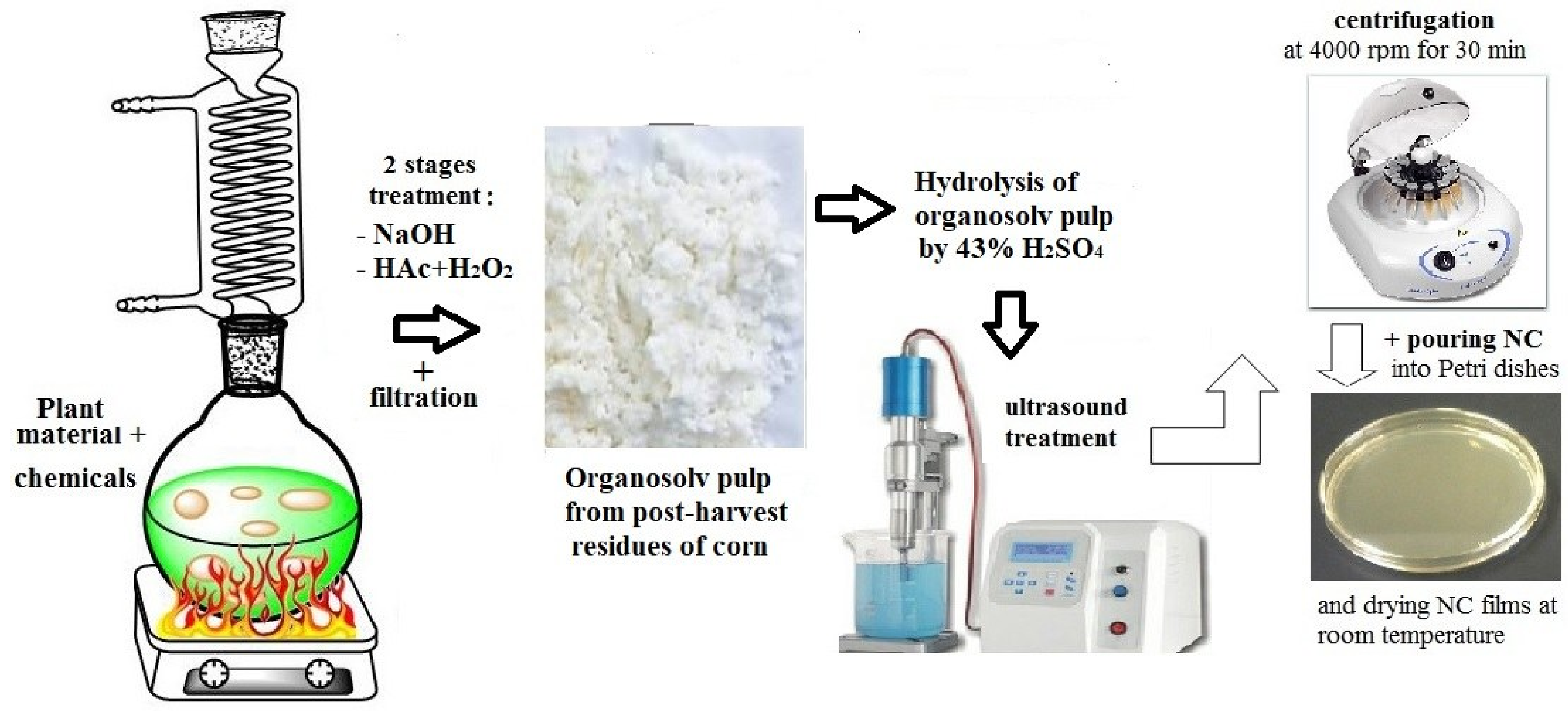
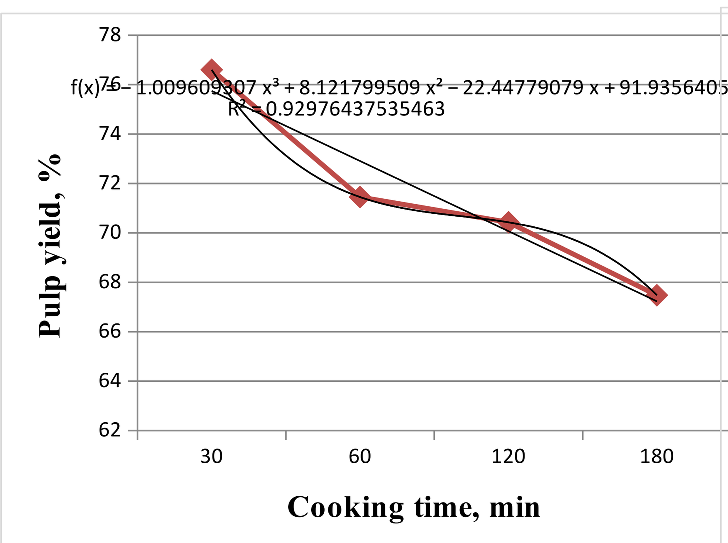
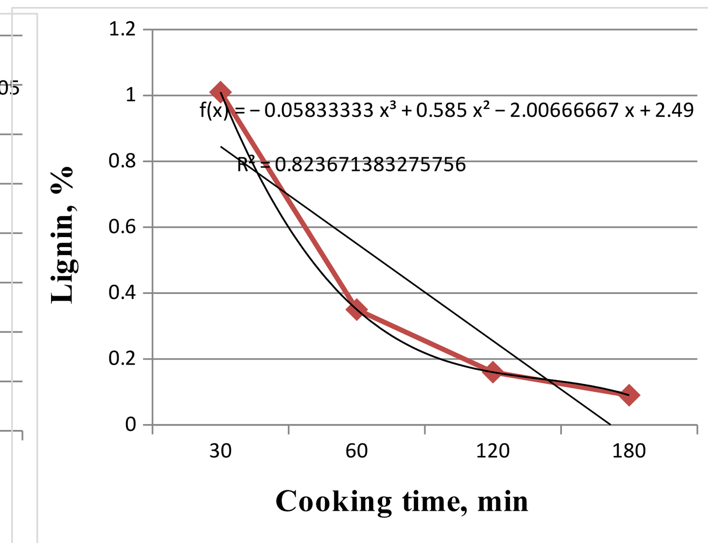
Nanocellulose is a biodegradable material with high mechanical strength, transparency and chemical resistance, light weight and low coefficient of thermal expansion. Nanocellulose is widely used in industry to increase the mechanical strength and improve the barrier properties of paper and cardboard, polymer and cement composites, electric batteries and sorbents. In world practice, the main source for obtaining nanocellulose is wood. For countries with developed agriculture and a limited supply of wood, the development of technologies for the extraction of nanocellulose from non-wood plant materials is relevant. A representative of such raw materials is corn - one of the most widespread and important agricultural crops in the world. During harvest, up to 1 ton per hectare of spent corn residue is produced annually, which can be used for nanocellulose extraction.

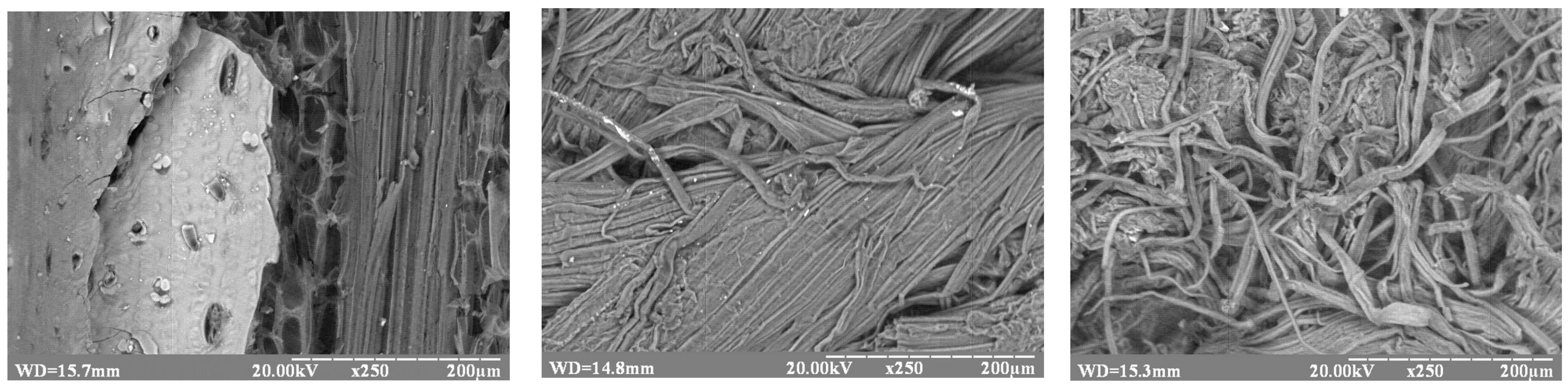
The study described the extraction of organosolv pulp and nanocellulose from post-harvest corn by environmentally friendly organosolv method of delignification with using NaOH solution and cooking with a mixture of acetic acid and hydrogen peroxide and hydrolysis of obtained organosolv pulp by H_2SO_4. The scheme for obtaining nanocellulose has the following form:





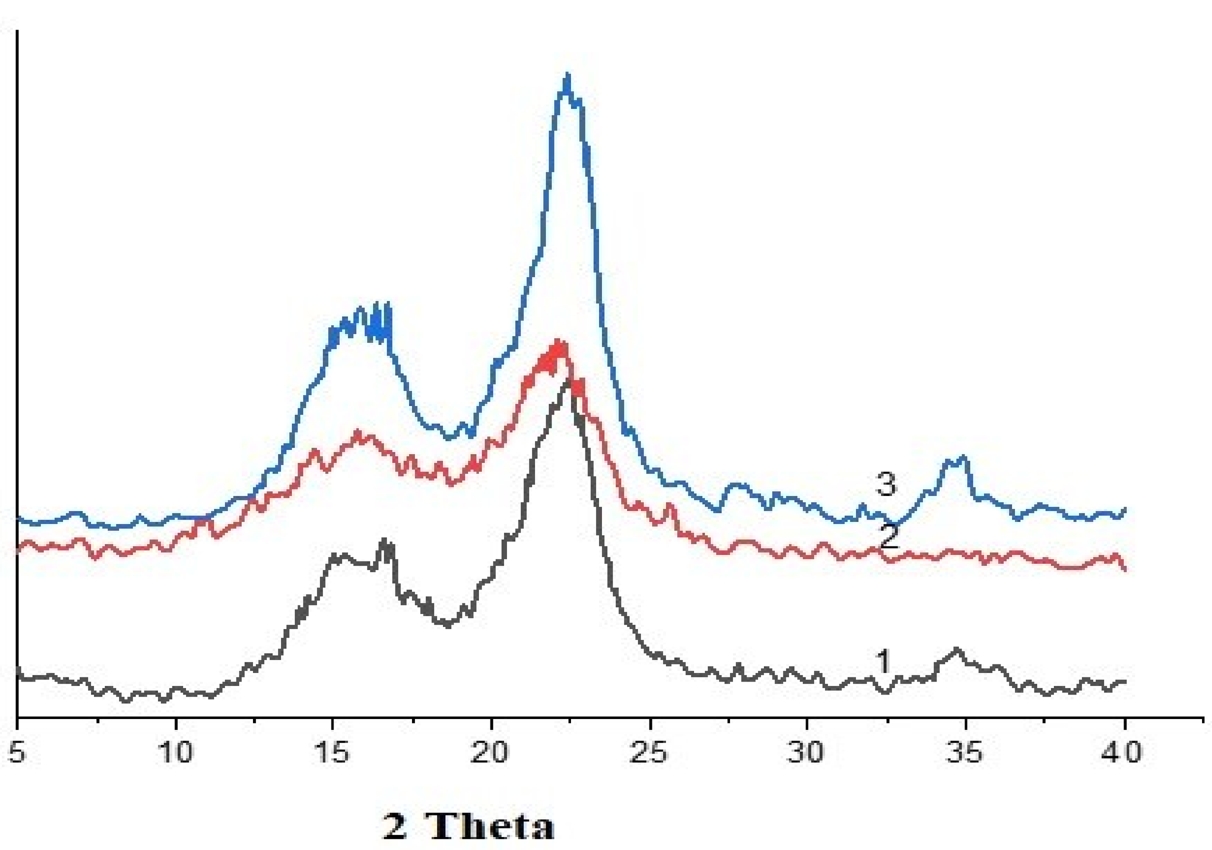


To obtain nanocellulose, we used organosolv pulp, obtained as a result of alkaline treatment for 180 min and organosolv cooking for 180 min, which had a residual lignin content of 0.09% and a ash content of 1.01%. Structural changes in plant material are shown below in SEM images:

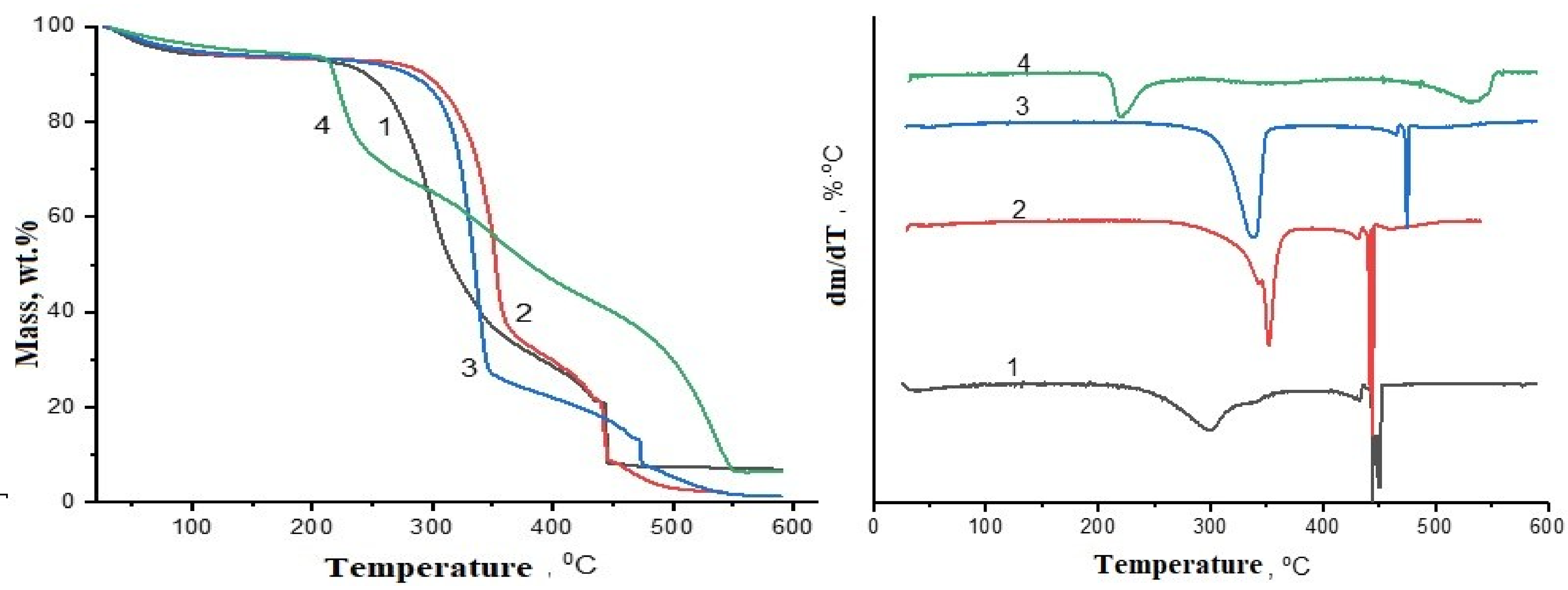


post-harvest corn *pulp after NaOH treatment* *organosolv pulp*

As a result of the hydrolysis of organosolv pulp with sulfuric acid solutions of concentration 43% and 50%, a transparent stable nanocellulose gel was obtained, the films of which had a density of about 1 g/cm3, a tensile strength of 18 MPa.



X-ray diffraction patterns: post-harvest corn (1), pulp after NaOH treatment (2), organosolv pulp (3)



TG (a) and DTG (b) curves of thermal analysis: post-harvest corn (1), pulp after NaOH treatment (2), organosolv pulp (3) and nanocellulose (4)

Structural (XRD) and thermal (TGA) analyzes confirmed that increasing the amount of sulfuric acid, temperature and duration of the cellulose hydrolysis process improves the quality indicators of corn nanocellulose. This dependence of nanocellulose quality indicators on the technological parameters of the hydrolysis process is characteristic of nanocellulose from other representatives of renewable plant materials (wheat straw, reed, flax, hemp, kenaf, miscanthus).